REPORT OF SEDIMENTATION SURVEY

LAKE DANIEL

STEPHENS COUNTY, TEXAS

1970

UNITED STATES
DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

4-30892 9-71
USDA-SCS-FORT WORTH, TEX. 1971

Report of Sedimentation Survey

LAKE DANIEL

Stephens County, Texas

1970

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United States Department of Agriculture

Soil Conservation Service

Temple, Texas

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REPORT OF SEDIMENTATION SURVEY

LAKE DANIEL
STEPHENS COUNTY, TEXAS
October-November, 1970

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REPORT OF SEDIMENTATION SURVEY

LAKE DANIEL

STEPHENS COUNTY, TEXAS

October - November 1970

INTRODUCTION

This report describes the results of a sedimentation survey of Lake Daniel, Stephens County, Texas made by the United States Department of Agriculture, Soil Conservation Service, Temple, Texas, in cooperation with the City of Breckenridge. The survey was made at the request of the Lower Clear Fork of the Brazos Soil and Water Conservation District and was conducted during the period October 20 to November 19, 1970. There were no previous sedimentation investigations on the reservoir prior to this survey.

Lake Daniel and Gonzales Creek Dam are owned by the City of Breckenridge. Water rights for the storage of 11,400 acre-feet and annual use of 2,500 acre-feet were obtained by M. E. Daniel from the State Board of Water Engineers in 1946 and were transferred, on October 5, 1948, by deed to the City of Breckenridge. Lake Daniel furnishes the municipal and industrial water supply for the City. Construction of the dam began December 15, 1947, and was completed on September 1, 1948. The lake was first filled in June 1949. A small diversion dam and pumping equipment installed near the City were placed in operation March 1951.(1)

Drought conditions at the time of this survey caused a lowering of the lake level approximately 11 feet from the previous year, and not having a knowledge of the decrease in capacity due to sediment deposition in the lake caused concern as to the adequacy of the remaining water storage for the City's future needs. The City had previously entered into an agreement with the West Central Texas Municipal Water District, which owns and operates Hubbard Creek Reservoir, for its future municipal water supply needs. Continuation of the drought caused the City of Breckenridge to initiate the construction of a pipeline and service equipment to Hubbard Creek Reservoir, but until this work is completed, any rationing of water use by the City will be based upon the results of this sedimentation survey of Lake Daniel.

OBJECTIVES OF THE SURVEY

Major objectives of the investigation were (1) to determine the capacity loss of the reservoir due to sedimentation, (2) to determine the annual rate of sediment production per unit of drainage area, (3) to determine the characteristics of sediment deposition in the reservoir, and (4) to evaluate the effects of conservation practices in the watershed on sediment yield to the lake.

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LAKE DANIEL SYSTEM

Location - Lake Daniel is located 7 miles south of Breckenridge, Stephens County, Texas. The dam is constructed across Gonzales Creek, a tributary of Clear Fork of the Brazos, which is a major tributary to the Brazos River.

The Dam and Spillway - The dam is an earthfill structure 2,500 feet long and 38 feet high with the top of the dam at elevation 1293.0 feet above mean sea level. The embankment has a maximum bottom width of 250 feet and top width of 18 feet. The upstream surface is protected with 15 inches of rock riprap on a 6-inch gravel base.

The service spillway is a rectangular concrete drop-inlet structure discharging to a double-barrel concrete conduit, each barrel of which is 8 feet wide by 8 feet high with a circular top. Eighteen-inch, slide-gate-controlled inlets at elevation 1272.0 and 1257.0 feet above m.s.l. are used to supply the downstream releases. Two gates in the interior walls of the structure with invert at elevation 1250.0 feet above m.s.l. regulate the flow to each of the large conduit barrels. When the water level is above the lip of the inlet at elevation 1278.0 feet above m.s.l., the flow is uncontrolled through both barrels of the large conduit.(1) An emergency spillway is located in a topographic saddle west of the abandoned railroad abutment. Its crest elevation is 1284.5 feet above m.s.l., and the discharge is over natural ground to the creek channel below the dam.

The Reservoir - Storage began in Lake Daniel in September 1948 and the lake was first filled in June 1949.

The original surface area of the lake at service spillway crest elevation was 924 acres, and the original capacity was 10,731 acre-feet, as determined by this survey.

The reservoir is composed of two principal arms. The largest and the major contributing source is Gonzales Creek, which drains from the south and enters at the southeast side of the lake. Big Branch, a tributary of Gonzales Creek, enters the lake near its mid-point and its drainage is also from the south. A smaller unnamed tributary enters the reservoir from the west. The emergency spillway is located at the upper end of this small tributary.

Topography of the shoreline is fairly irregular. Limestones and sandstones of Pennsylvanian Age present very steep slopes, especially in the vicinity of the dam abutments, along the island separating the two major arms of the lake, and along parts of the south shoreline. Elsewhere, the shoreline has a gently sloping configuration.

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THE WATERSHED

Topography and Drainage - The land surface is generally rolling with some hills. The altitude ranges from about 1,250 to 1,650 feet, the total relief being about 400 feet.

The Lake Daniel watershed lies entirely within the Brazos River drainage system. Gonzales Creek, which flows north into the lake, drains the south central part of Stephens County and a small area in the northern part of Eastland County.

General Geology - With the exception of an isolated erosional remnant of the Trinity Group which unconformably overlies rocks of Pennsylvanian Age in southeastern Stephens County, the drainage area above Lake Daniel consists of rocks of the Pennsylvanian System. This area lies entirely within the Cisco Group (middle Pennsylvanian). The majority of the watershed in this group is comprised of limestones and sandstones of the Thrifty and Graham Formations. A smaller portion of the watershed is within the outcrop of the Harpersville Formation consisting of limestone strata.

Climate - The climate of Lake Daniel watershed is classified as dry subhumid with an average annual rainfall of 25.16 inches. The maximum annual rainfall was recorded as 46.78 inches at Breckenridge in 1957, and the minimum was recorded as 13.01 inches in 1956.

The mean annual temperature is 65 degrees Fahrenheit, ranging from 44 degrees in January to 84 degrees in July.

The average annual lake evaporation is estimated at 54 inches.(2)

The mean annual runoff is 2.15 inches or 13,186 acre-feet as determined from Soil Conservation Service "Average Annual Runoff Map", 1954.

Land Resource Area and Soils - The watershed of Lake Daniel lies entirely within the Central Rolling Red Prairies Land Resource Area.

The watershed is represented by the following soils:(3)

Soil Series	Percentage of Watershed Area Covered
Truce --- fine sandy loam	30
Hubbard --- fine sandy loam	15
Exray-Bonti "Complex" --- stony fine sandy loam	20
Thurber and Tobosa --- clay loam and clay	8
Owens --- clays	25
Gowen --- clay loams (bottomland)	2
	100

Land Use - The overall land use for the watershed is as follows:

Land Use	Acres	Percent
Cropland	8,832	12
Rangeland	62,560	85
Lake Daniel	924	1
Miscellaneous 1/	1,284	2
Total	73,600	100

1/ Includes roads, highways, farmsteads, etc.

Erosion and Sediment Production - Generalized sediment source studies were made in the drainage area of the lake. These studies included tabulating soils; slope length in feet and the percent of slope; land use; treatment on cultivated land; cover conditions on rangeland; and lengths, widths, depths, and estimated lateral erosion of gullies and stream channels. Separate studies were made based upon land use, cover conditions, and conservation practices in effect in 1948 and 1970.

In computing gross erosion, the quantity of material derived from sheet erosion and channel erosion are computed separately. Sheet erosion was computed by use of the Musgrave(4) equation. Channel erosion was computed by a formula described by Renfro.(5)

Under 1948 conditions, the estimated annual gross erosion from all sources was 115 acre-feet. Application of conservation practices in the watershed has reduced this erosion to 103 acre-feet, a decrease of 10 percent. Sheet erosion accounts for approximately 78 percent of the total erosion. Streambank and gully erosion account for the remaining 22 percent.

The average annual sediment yield to the reservoir is 29.6 acre-feet. The reservoir has an estimated trap efficiency of 96 percent. The density of submerged sediment is only 48 pounds per cubic foot as compared to a density of 96 pounds per cubic foot for in-place soil. Due to this significant difference in densities, sediment occupies twice as much space in the reservoir as it does as soil in place. Thus the average annual capacity loss due to sediment deposition is 56.8 acre-feet.

A comparison of the average annual gross erosion in the watershed to the average annual sediment yield to the reservoir was made. This shows that, during the life of the reservoir, 27 percent of the erosional material has been delivered to and deposited in the reservoir.

SURVEY METHODS AND CALCULATIONS

Daily water surface elevations were obtained from the staff gage located adjacent to the drop-inlet structure. Elevations were then taken from the water surface to the range ends by use of a level. Permanent range end markers were established to aid in any future surveys which may be made. A steel airplane cable was stretched from shore to shore on line between the range ends. Floats were attached to the cable to facilitate the cable stretching process and also served as a warning to approaching boats in the area. A boat with a line meter was then attached to the cable, and as it traversed along the range, distances of the measurements were recorded. Water depths were measured with a 5-pound conical-shaped sounding pea attached to a graduated copper-cored line. Sediment thicknesses were obtained with grooved spud bars and sounding poles.

Sediment samples were obtained with a piston type sampler which employs a clear plexiglass tube inserted inside the aluminum outer cylinder. The plexiglass tube affords the advantages of non-compression of sediment, visual examination of the sample, complete recovery of the semi-fluid upper layer of sediment, and accurate measurements of sample volume. Representative samples were submitted for testing.

Original and present capacities were computed using the prismoidal formula as described by Eakin and Brown.(6)

An area and capacity table was prepared by using the contour map plotted from the present water depth measurements taken during this survey. (See Table 3.)

SEDIMENTATION IN THE RESERVOIR

Character of Sediment - Eight sediment samples were taken from the reservoir, consisting of 6 submerged and 2 aerated samples. The location of the samples obtained is shown on the survey map, Figure 1. The submerged samples had an average composition of 77 percent clay, 14 percent silt, and 9 percent fine sand size particles. The texture of the aerated samples consisted of 52 percent clay, 31 percent silt, and 17 percent fine sand size particles. Because the heavier, or larger size particles, will be the quickest to settle out of suspension as the water velocity drops when entering the lake, an increase in the texture size composition of the aerated samples, taken toward the upper portion of the reservoir, is to be expected. The sediments are primarily dark brown in color.

Distribution of Sediment - As shown by the segment data, Table 2, the greatest capacity loss due to sediment is in segment 8. This is due to the influence of the abandoned railroad embankment immediately below the lower end of this segment. This embankment restricts the normal flow of water which has to be diverted to a small outlet on its north end and causes a large quantity of the suspended material to settle out above it. With the exception of this segment, sediment distribution is uniformly graded from the head of the lake to the dam, with the greater capacity losses in the upper segments and the smaller capacity losses in the lower segments. The reservoir has an over-all capacity loss of 11.33 percent.

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Volume Weight of Sediment - As previously stated, 6 samples were taken from areas of the reservoir which have not been exposed to air drying and 2 aerated samples taken from the upper dry areas. The submerged samples, described as being the finer textured sediments, also had a lighter average unit dry weight. These samples averaged 39 pounds per cubic foot. The aerated samples had an average unit dry weight of 69 pounds per cubic foot. The unit dry weight of all samples had a weighted average of 48 pounds per cubic foot. The average unit dry weight of upland soils is 96 pounds per cubic foot.

Trap Efficiency of Reservoir - The trap efficiency of sediment for Lake Daniel is 96 percent. This was obtained by using curves developed by Brune(7) which relate capacity-inflow to the percent of sediment trapped.

SOIL CONSERVATION

Conservation treatment on lands in the watershed is carried out under the direction of the Lower Clear Fork of the Brazos and the Upper Leon Soil and Water Conservation Districts assisted by the Soil Conservation Service work units in Breckenridge and Eastland. This effective conservation program is based upon the use of each acre of agricultural land within its capabilities and treatment in accordance with its needs. The work units have assisted ranchers and farmers in preparing soil and water conservation plans on 67,330 acres (95 percent of agricultural land) within the watershed and have given technical assistance in establishing and maintaining the planned measures. To date, approximately 65 percent of the planned practices have been applied. Much of the land in the watershed not under cooperative agreement has received some conservation treatment.

Land treatment measures decrease erosion and the resultant sediment yield from rangeland and cropland by providing improved soil-cover conditions. On grassland they include proper use, range seeding, and brush control to improve grass cover; farm ponds to provide livestock water; and proper distribution of grazing to improve, protect, and maintain grass stands. The measures include conservation cropping systems, cover and green manure crops, and crop residue use for cropland. All these measures also effectively improve soil conditions and increase infiltration of rainfall into the soil.

Much of the vegetative cover in the watershed was poor during the drought years 1951-1957 and probably accounts for much of the sediment deposited in Lake Daniel. As a result of normal rains and conservation treatment, the area has made a good recovery since 1957.

Land treatment measures applied since construction of the lake have reduced the rate of sediment production by 10 percent. As additional land treatment measures are applied, it is expected that the present rate of sediment accumulation in the reservoir will be further reduced.

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SUMMARY OF DATA

As shown by the Reservoir Sediment Data Summary Sheet, Table 1, the reservoir has lost 1,216 acre-feet of its original capacity due to sedimentation during its 21.4-year life. The average annual rate of deposition is 56.8 acre-feet, which represents a rate of 0.49 acre-foot per square mile of watershed area. The total capacity loss of the reservoir to date is only 11.3 percent, which represents an average annual loss of 0.53 percent. Conservation treatment measures by ranchers and farmers in the watershed have reduced the rate of sediment production by 10 percent since 1948.

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REFERENCES

1. Texas Water Development Board Report 48, Dams and Reservoirs in Texas, June 1967.

2. Texas Water Commission Bulletin 6412, Occurrence and Quality of Ground Water in Stephens County, Texas, September 1964.

3. Williams, John S., unpublished soils mapping in Lake Daniel Watershed from District Conservationist, U.S. Dept. of Agriculture, Soil Conservation Service, Breckenridge, Texas.

4. Musgrave, G. W., The Quantitative Evaluation of Factors in Water Erosion - A First Approximation, Journal of Soil and Water Conservation, Vol. 2, No. 3, pp 133-138, July 1947.

5. Renfro, G. W. and Moore, C. M., Sedimentation Studies in the Western Gulf States, Proceedings, ASCE, Hydraulics Div., Oct. 1958.

6. Eakin, H. M., Silting of Reservoirs, U.S. Dept. of Agriculture Tech. Bull. 524 (Revised by C. B. Brown), 166 pp. illus., 1939.

7. Brune, G. M., Trap Efficiency of Reservoirs, Trans. American Geophys. Union, Vol. 34, No. 3, pp 407-418, June 1953.

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RESERVOIR SEDIMENT
DATA SUMMARY
SCS-34 Rev. 6-66

TABLE 1

LAKE DANIEL
NAME OF RESERVOIR

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DATA SHEET NO.

DAM

1. OWNER City of Breckenridge	2. STREAM Gonzales Creek	3. STATE Texas
4. SEC. -- TWP. -- RANGE --	5. NEAREST P. O. Breckenridge	6. COUNTY Stephens
7. LAT. 32° 39' 00" LONG. 98° 52' 10"	8. TOP OF DAM ELEVATION 1293	9. SPILLWAY CREST ELEV. 1278 1/

RESERVOIR

10. STORAGE ALLOCATION	11. ELEVATION TOP OF POOL	12. ORIGINAL SURFACE AREA, ACRES	13. ORIGINAL CAPACITY, ACRE-FEET	14. GROSS STORAGE, ACRE-FEET	15. DATE STORAGE BEGAN
a. FLOOD CONTROL					9-48
b. MULTIPLE USE					
c. POWER					16. DATE NORMAL OPER. BEGAN
d. WATER SUPPLY	1278.0	924	10,731	10,731	
e. IRRIGATION					6-49
f. CONSERVATION					
g. INACTIVE					

17. LENGTH OF RESERVOIR 4.52 MILES — AV. WIDTH OF RESERVOIR 0.44 MILES

WATERSHED

18. TOTAL DRAINAGE AREA 115 SQ. MI.		22. MEAN ANNUAL PRECIPITATION	25.16 (42) INCHES
19. NET SEDIMENT CONTRIBUTING AREA 113 SQ. MI.		23. MEAN ANNUAL RUNOFF	2.15 INCHES
20. LENGTH 12.0 2/ MILES	AV. WIDTH 9.58 MILES	24. MEAN ANNUAL RUNOFF	13,186 AC.-F T.
21. MAX. ELEV. 1650	MIN. ELEV. 1250	25. ANNUAL TEMP.: MEAN	65°F RANGE 44°F - 84°F

SURVEY DATA

26. DATE OF SURVEY	27. PERIOD YEARS	28. ACCL. YEARS	29. TYPE OF SURVEY	30. NO. OF RANGES OR CONTOUR INT.	31. SURFACE AREA, ACRES	32. CAPACITY, ACRE-FEET	33. C/I. RATIO, AC.-FT. PER AC.-FT.
6-49	--	--	Range (D)	17 Ranges	924	10731	0.81
11-70	21.4	21.4			924	9515	0.72

26. DATE OF SURVEY	34. PERIOD ANNUAL PRECIPITATION	35. PERIOD WATER INFLOW, ACRE-FEET			36. WATER INFL. TO DATE, AC.-FT.	
		a. MEAN ANNUAL	b. MAX. ANNUAL	c. PERIOD TOTAL	a. MEAN ANNUAL	b. TOTAL TO DATE

26. DATE OF SURVEY	37. PERIOD CAPACITY LOSS, ACRE-FEET			38. TOTAL SED. DEPOSITS TO DATE, ACRE-FEET		
	a. PERIOD TOTAL	b. AV. ANNUAL	c. PER SQ. MI.-YEAR	a. TOTAL TO DATE	b. AV. ANNUAL	c. PER SQ. MI.-YEAR
11-70	1216	56.8	0.49	1216	56.8	0.49

26. DATE OF SURVEY	39. AV. DRY WGT., LBS. PER CU. FT.	40. SED. DEP., TONS PER SQ. MI.-YR.		41. STORAGE LOSS, PCT.		42. SED. INFLOW, PPM	
		a. PERIOD	b. TOTAL TO DATE	a. AV. ANN.	b. TOT. TO DATE	a. PERIOD	b. TOT. TO DATE
11-70	48 (8)	512	512	0.53	11.3	--	--

26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE IN FEET BELOW, AND ABOVE, CREST ELEVATION											
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION											

26. DATE OF SURVEY	44. REACH DESIGNATION PERCENT OF TOTAL ORIGINAL LENGTH OF RESERVOIR													
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	-105	-110	-11●	-120	-125
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN REACH DESIGNATION														

45. RANGE IN RESERVOIR OPERATION

WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.	WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.

46. ELEVATION-AREA-CAPACITY DATA

ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY

(See Table 3)

47. REMARKS AND REFERENCES

1/ Service spillway crest elev. 1278; emergency spillway crest elev. 1284.5.

2/ Reservoir composed of two principal arms. Lengths of each arm are as follows: Gonzales Creek arm = 2.57 miles
Big Branch arm = 1.95 miles

48. AGENCY MAKING SURVEY Soil Conservation Service-Texas

49. AGENCY SUPPLYING DATA Sedimentation Survey Party 50. DATE 3-71

USDA-SCS-HYATTSVILLE MD 1966
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TABLE 2

SEGMENT DATA
LAKE DANIEL
1970 SURVEY

SEGMENT	ORIGINAL SURFACE AREA (Acres)	ORIGINAL CAPACITY (Ac.-Ft.)	CAPACITY AT DATE OF SURVEY (Ac.-Ft.)	SEDIMENT VOLUME (Ac.-Ft.)	CAPACITY LOSS (Percent)
1	30.10	600.00	552.00	48.00	8.00
2	70.40	1532.08	1390.30	141.78	9.25
3	93.00	1806.10	1626.84	179.26	9.92
4	35.00	659.61	600.64	58.97	8.94
5	93.50	1355.80	1217.44	138.36	10.20
6	113.80	1346.63	1193.19	153.44	11.39
7	89.40	872.52	766.24	106.28	12.18
8	42.00	359.71	300.73	58.98	16.37
9	51.00	316.02	262.44	53.58	16.95
10	60.60	212.01	170.13	41.88	19.75
11	15.00	40.34	34.28	6.06	15.02
12	39.00	440.48	382.33	58.15	13.20
13	38.40	323.89	266.50	57.39	17.72
14	39.00	210.24	177.21	33.03	16.41
15	45.19	110.56	97.20	13.36	12.08
16	35.00	366.34	320.99	45.35	12.38
17	12.10	51.82	37.04	14.78	28.52
18	21.20	126.64	119.09	7.55	5.96
Total*	923.69	10730.79	9514.59	1216.20	11.33

*Totals are for data at service spillway crest elevation 1278 msl.

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TABLE 3

AREA AND CAPACITY DATA
LAKE DANIEL
1970 SURVEY

ELEVATION	AREA Acres	CAPACITY Acre-Feet	CAPACITY Gallons
1250.0	0.9	2	651,700
1254.0	7	19	6,191,150
1257.0	15	40	13,034,000
1258.0	33	101	32,910,850
1259.0	44	120	39,102,000
1260.0	67	290	94,496,500
1261.0	105	450	146,632,500
1262.0	241	662	215,712,700
1263.0	270	900	293,265,000
1264.0	292	1186	386,458,100
1265.0	318	1506	490,730,100
1266.0	344	1860	606,081,100
1267.0	383	2247	732,184,950
1268.0	420	2677	872,300,450
1269.0	463	3137	1,022,191,450
1270.0	511	3609	1,175,992,650
1271.0	559	4142	1,349,670,700
1272.0	612	4728	1,540,618,800
1273.0	668	5400	1,759,590,000

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TABLE 3 (Continued)

AREA AND CAPACITY DATA
LAKE DANIEL
1970 SURVEY

ELEVATION	AREA Acres	CAPACITY Acre-Feet	CAPACITY Gallons
1274.0	727	6139	2,000,393,150
1275.0	779	6905	2,249,994,250
1276.0	829	7730	2,518,820,500
1277.0	878	8617	2,807,849,450
1278.0	924	9515	3,100,462,750
1284.5	1578	17827	5,808,927,950

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LEGEND
Contour Interval 4 Feet
SEDIMENTATION SURVEY - 1970
LAKE CAMEL
STEPHENS COUNTY
TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
4-R-30,103-S

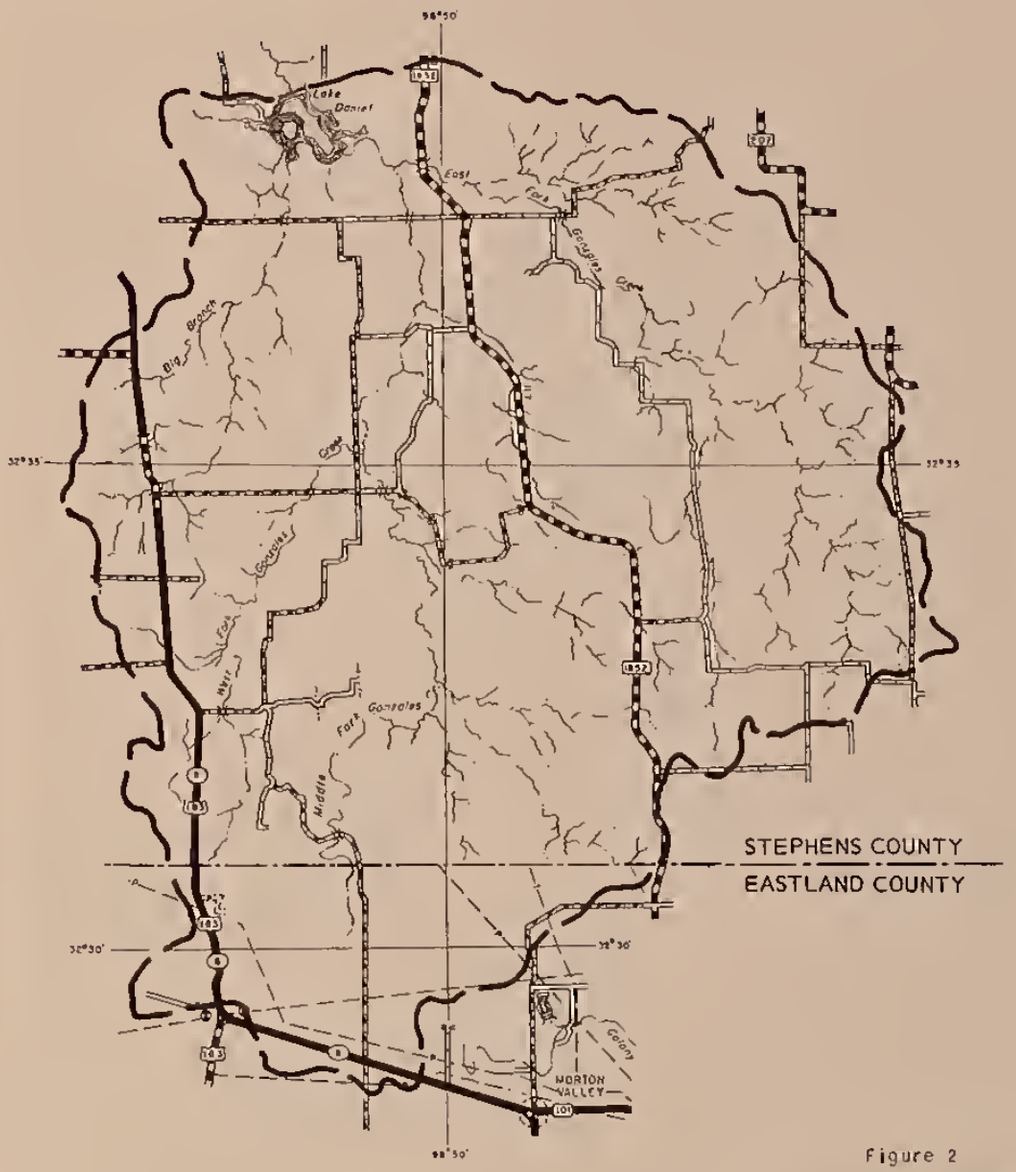

Figure 2

LAKE DANIEL WATERSHED

Stephens and Eastland Counties

Texas

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

N

0 2 4 6 Miles

Approximate Scale — 1:126,720 or 1 in. = 2 mi.

Base—General Highway Maps, 1967 Revision, Texas State Highway Dept. and USDC, Bureau of Public Roads.

Feb. 1971

4-R-30154

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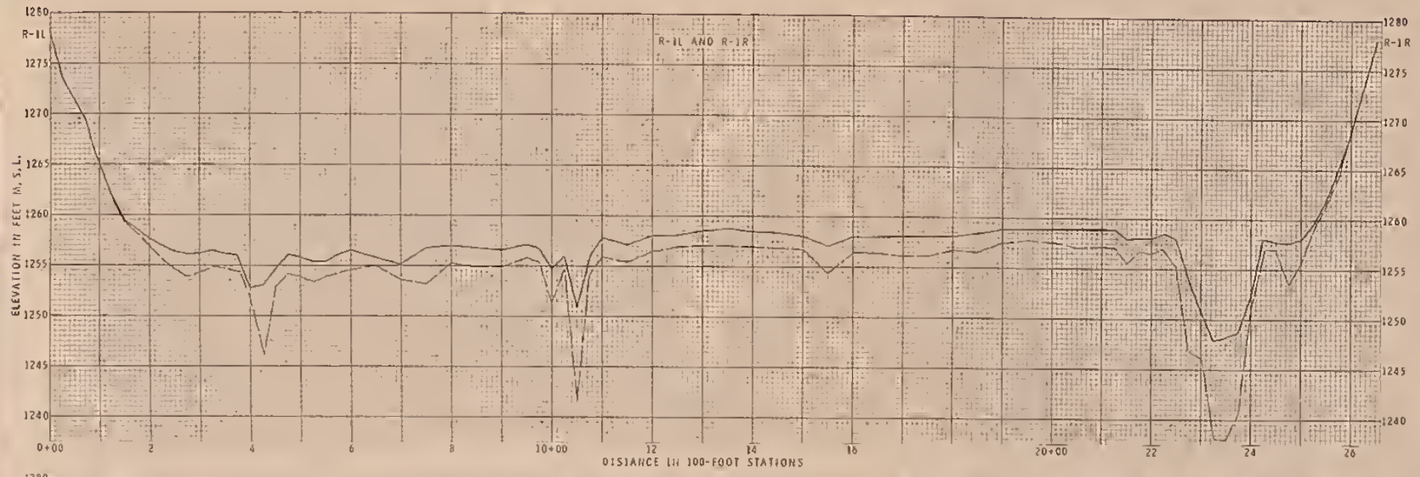
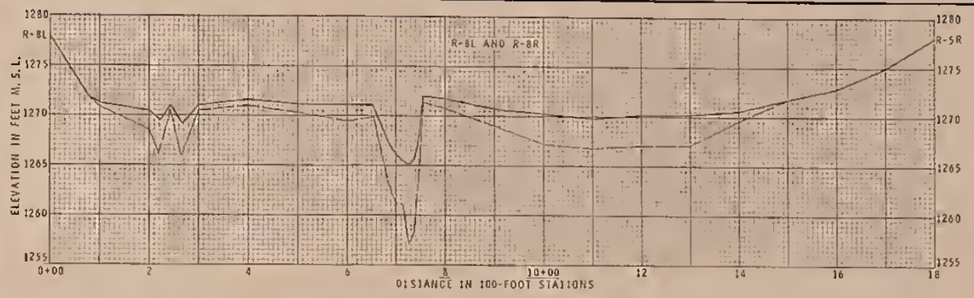
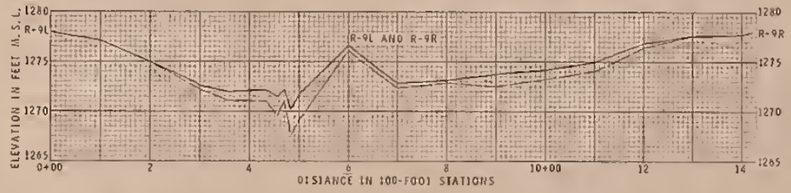
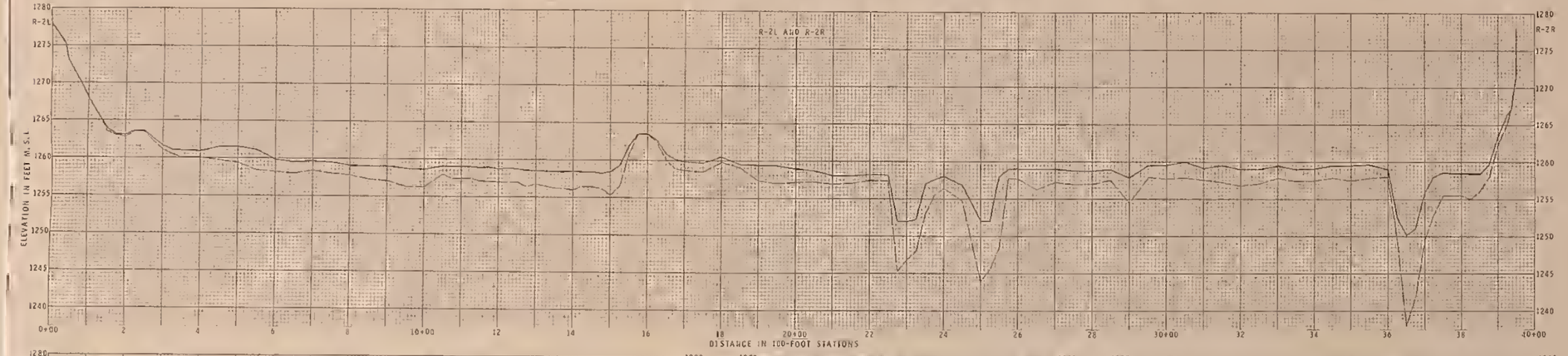
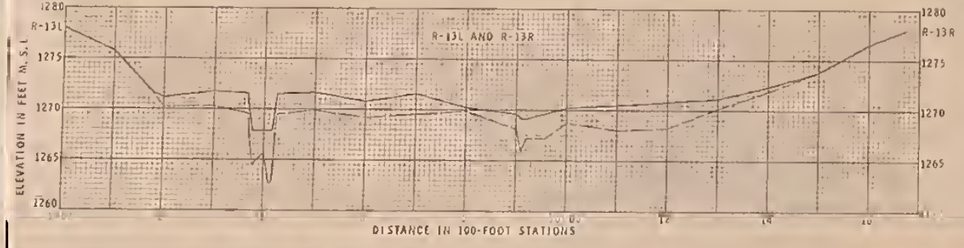
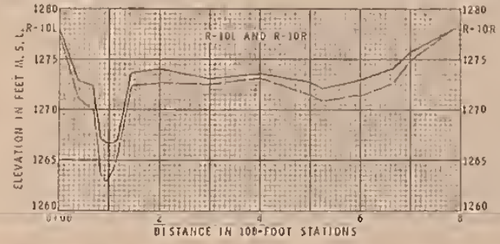


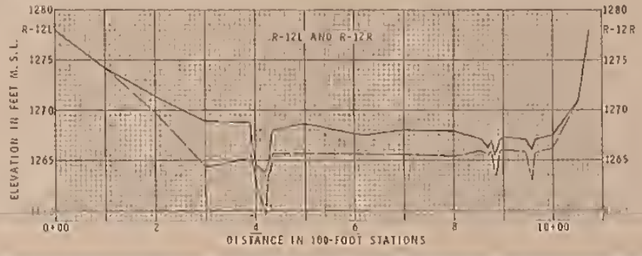












LEGEND

1970 SURVEY

ORIGINAL BOTTOM

RANGE-1RIGHT (R-1R)

RANGE-1LEFT (R-1L)

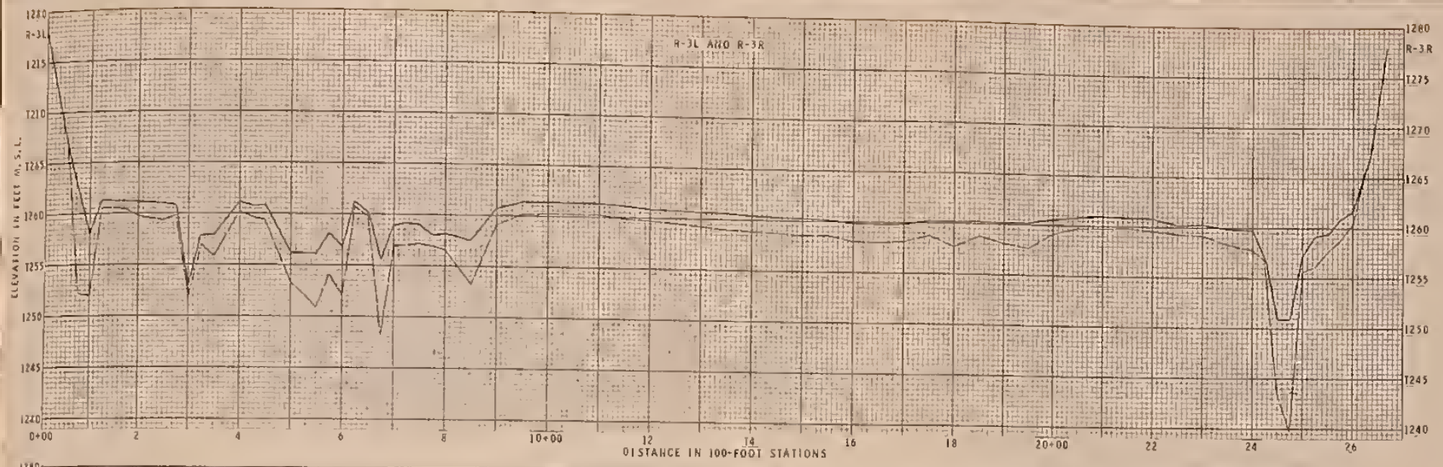
Figure 3

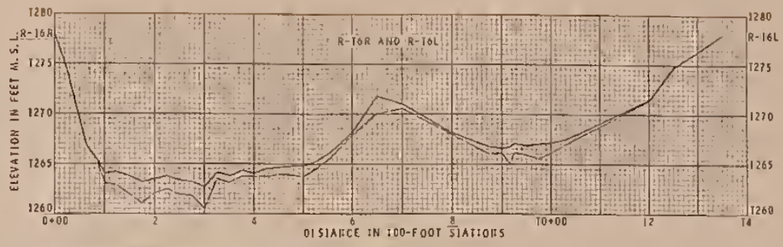
RANGES 1, 2, 8, 9, 12, 13 & 15
SEDIMENTATION SURVEY-1970
LAKE DANIEL
IN
STEPHENS COUNTY, TEXAS

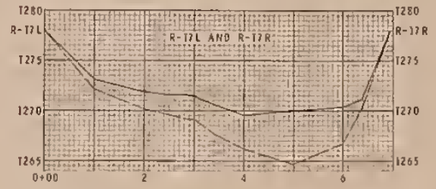
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

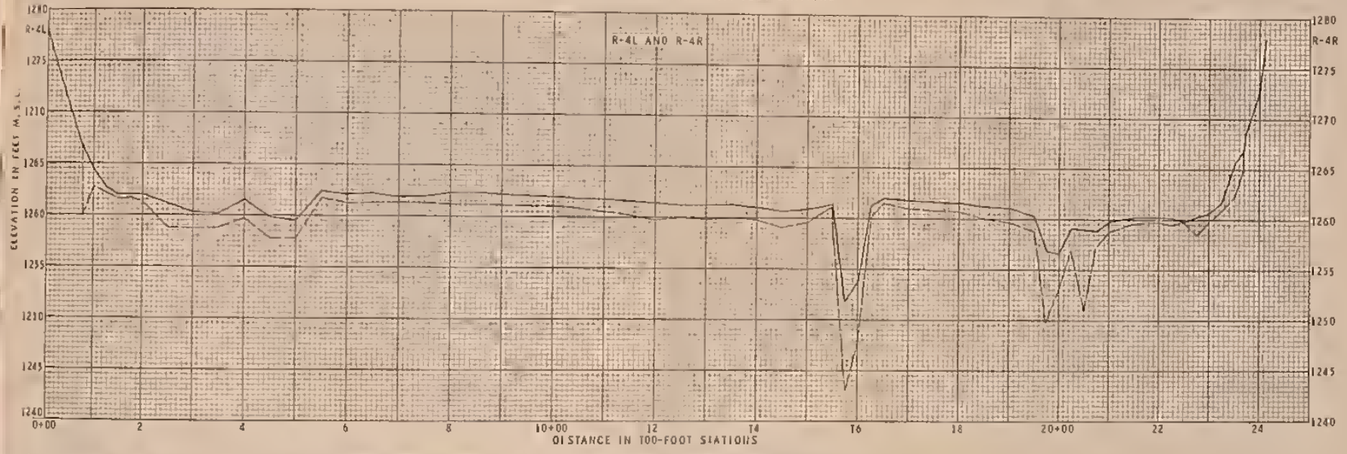
		Date
R.H. Zoch		8-70
R.H. Zoch		8-70
F.I.B.		3-71
Checked: W.L.B.		3-71

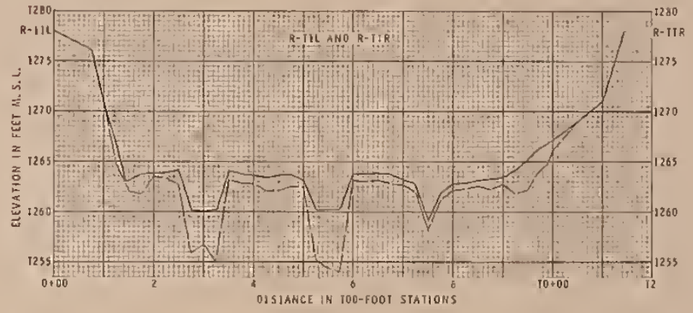
4-R-30,190-S

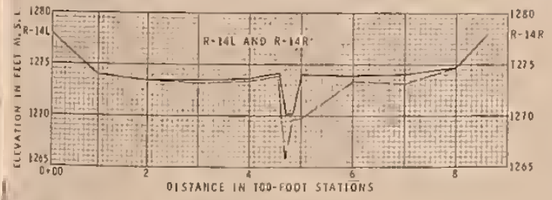


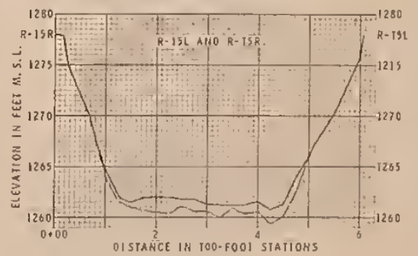


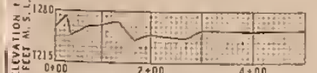












PROFILE OF OLD R.R. FILL

L E G E N D

1970 SURVEY

ORIGINAL BOTTOM

RANGE-1 LEFT (R-TLT

RANGE-1 RIGHT (R-TR)

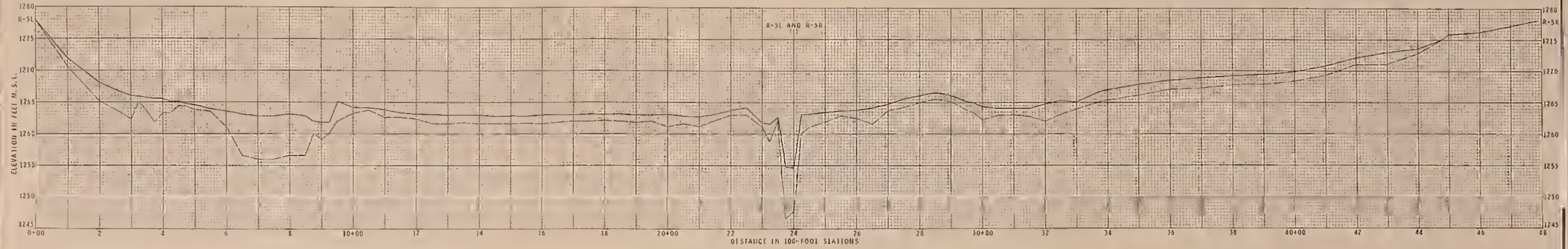
Figure 3

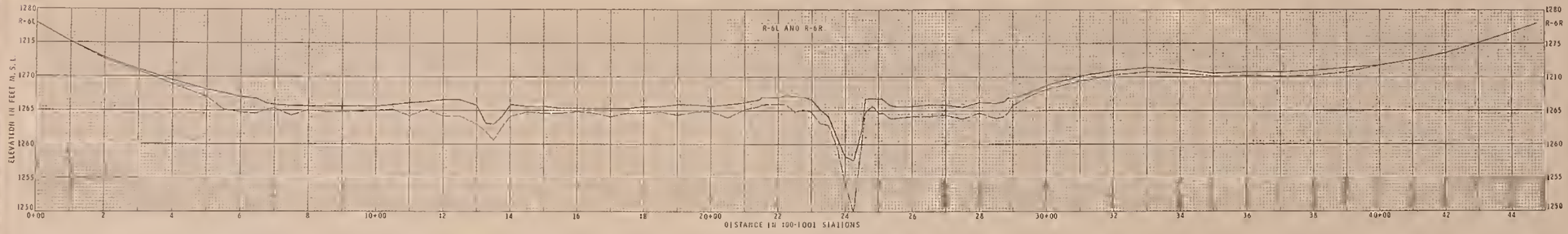
RANGES 8, 9, 10, 15, 16 & 17
SEDIMENTATION SURVEY - 1970
LAKE DANIEL
IN
STEPHENS COUNTY, TEXAS

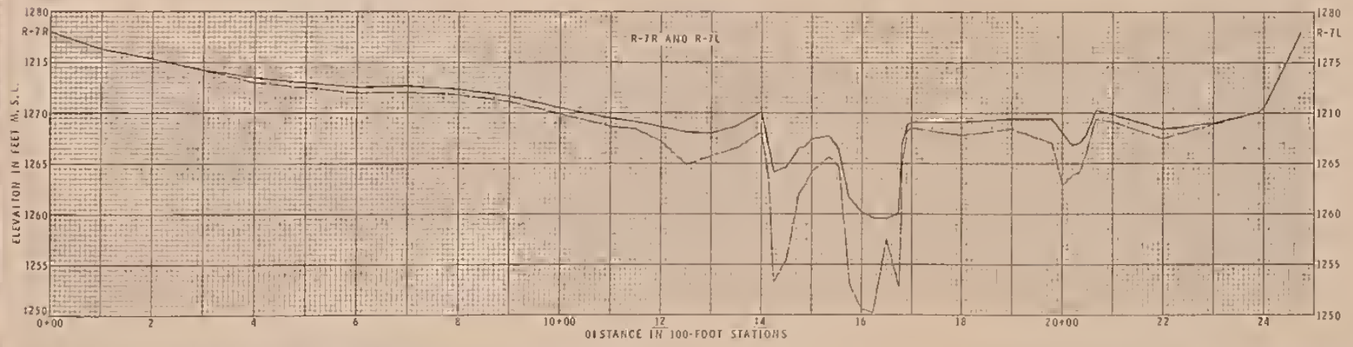
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R.H.Kelly	8-70	
Drawn R.H.Eaton	8-70	
Traced F.I.B.	3-71	
Checked W.L.B.	3-11	Sheet No. 2 of 2 sheets

Drawing No. 4-R-30,190-S







L E G E N D

1970 SURVEY

ORIGINAL BOTTOM

RANGE - 1 RIGHT (R-1R)
RANGE - 1 LEFT (R-1L)

Figure 3

BERGER, F. S. I.
SEDIMENTATION SURVEY - 1970
LAKE DANIEL
in
STEPHENS COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed R.H. Eaton		8-72
Drawn R.H. Eaton		8-72
Traced F.I.B.		9-71
Checked W.L.B.		9-71

Drawing No. 4-R-30,190-S